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AUTHOR Scharf, John; And Others
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ABSTRACT

This document is a guide to the advanced placement program in calculus for grade 12 in the city schools in Warren, Ohio. The program covers analytic geometry, differential and integral calculus of algebraic functions, elementary transcendental functions, and applications of differentiation and integration. The philosophy and aims of the program are also discussed. (MM)

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CURRICULUM GUIDE

Advanced Placement Mathematics
CALCULUS

Grade 12

WARREN CITY SCHOOLS
WARREN, OHIO

1969

SE 012 224

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Curriculum Guide

ADVANCED PLACEMENT MATHEMATICS

C A L C U L U S

GRADE 12

Committee:

John Scharf, General Chairman
John Fender, Vice Chairman
Ronald Moreau, Chairman

CW

1969

F O R E W O R D

This curriculum guide has been prepared after an extensive examination of our course of study. The study was done by members of the teaching, supervisory and administrative staff under the direction of assistant superintendent in charge of curriculum and instruction.

The contents of this publication are designed to assist the classroom teacher in understanding the scope of his subject and its relationship to the entire curriculum and to help in the presentation of the material covered by this guide.

It is hoped that all members of the staff and particularly those teaching in this area will become familiar with the contents of this publication and use it as a GUIDE in planning and in the preparation for classroom instruction.

Our appreciation is expressed to all who contributed in any way to the development of this material. This is indeed a big step forward in the improvement of our education program.

DAVID L. MOBERLY
Superintendent of Schools

INTRODUCTION

The curriculum guide is intended to give direction to the teaching of subject matter in line with the purposes of each specific subject. The guide is the core of our instructional program, and it is hoped it will help to provide continuity and to reduce gaps in the learning experiences of pupils in the different subject areas.

The guide is a manual which outlines for the teacher the philosophy, aims, objectives, concepts, methods and techniques, teaching aids, and evaluative criteria. Since it suggests and places faith in the teachers' ingenuity and judgment, it is the modern approach toward curriculum improvement. It offers broad and varied curricular framework, and is organized to encourage such individuality as is appropriate to the schools of a democratic society.

In January, 1958, one hundred seventy curriculum committees were appointed and assigned the task of writing a curriculum guide for each of the subject areas of the curriculum of the Warren City Schools. By June, 1959, the task was accomplished after a total of 3,535 curriculum meetings, and a great "team" effort on the part of the teachers and administrators who served on the committees.

The committee approach was employed in writing the guides. This method was chosen because teachers familiar with their own course of study are best qualified to build their own curriculum guide. Although publications and materials by specialists were used by the committees, the ultimate decisions were made by those who have daily contact with the problem.

The tremendous growth of our school population includes all kinds of pupils: the handicapped, the very bright, the bright, the average and the slow. To educate all, we need to look to a realistic evaluation of our total curriculum if we are to meet the challenge of a sound and competent educational program.

These curriculum guides are not intended to limit either the pupil in learning or the teacher in teaching. No teacher is expected to use all of the activities suggested for any one unit in any grade, but he should adapt the materials to the individual needs of the pupils.

I believe the effective use of the many suggestions to be found in the curriculum guides will contribute immeasurably to better and more satisfying teaching.

I wish to express my sincere appreciation and thanks to all who shared in the preparation of the curriculum guides.

DAVID L. MOBERLY
Superintendent of Schools

Curriculum Guide

ADVANCED PLACEMENT MATHEMATICS

C A L C U L U S

GRADE 12

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Warren City Schools
Warren, Ohio

THIS WE BELIEVE

We, the staff of the Warren City Schools, believe:

1. That the schools must accept the RESPONSIBILITY, along with the home and the church, to provide the best possible educational opportunities for all children and youth of the community according to their needs, interests, and abilities

2. That LEARNING is a process which changes the learner's behavior in relation to his environment. It is, therefore, the duty of the schools to provide those experiences which will lead each child:

    a. To accomplish the physical, mental, and social changes in behavior which will encourage him to develop into a more competent and responsible person

    b. To develop high standards of human relations, healthful living, and vocational competency, and the desire to adapt to and improve his environment

    c. To become a responsible citizen willing and able to live as a productive, well-adjusted adult, with respect for self and others, and with appreciation for the dignity of all beneficial work

3. That the PURPOSES of the schools are:

    a. To develop each child's knowledge and use of the fundamental skills of language and mathematics, and the basic concepts of science

    b. To increase each child's understanding of the arts, sciences, and humanities, and to develop his appreciation of our cultural heritage

    c. To develop each child's moral and ethical standards, and the spiritual values which will result in desirable personal, social, and civic behavior

    d. To prepare each child to enter or to further prepare for a vocation that will permit him to develop and use to the fullest extent his interests and abilities

I. PHILOSOPHY

A. The Mathematics Department should accept fully the responsibility to provide each student the opportunity and encouragement to learn as much mathematics as his ability permits.

B. The learning of mathematics is a developmental process which affects the student's behavior. It is, therefore, the duty of the Mathematics Department to provide those mathematical experiences which will lead the student to develop in a manner consistent with the philosophy of the school.

II. BROAD SUBJECT AIMS

A. To cultivate clear and critical thinking.

B. To prepare students for the opportunity of Advanced Placement.

C. To furnish mathematical preparations in preparation for future vocations.

D. To develop each student's knowledge and use of the fundamental skills and basic concepts of mathematics.

E. To prepare each student for practical mathematical needs.

F. To contribute to each student's understanding and appreciation of his mathematical heritage.

G. To provide mathematical training for our future leaders of mathematics and other fields.

H. To create in the student an awareness of the importance of mathematics and the related physical sciences to our present culture.

I. To instill each student with high moral and ethical standards of conduct through mathematical principles which are eternal and exact.

III. SPECIFIC SUBJECT AIMS

A. To help the student build an understanding of the concepts of Analytic Geometry and Calculus.

B. To extend the ability of the student to apply the fundamental concepts of Calculus to real problems.

C. Develop an insight of the extreme usefullness of the Calculus.

D. To strengthen the deductive reasoning process.

E. To develop an appreciation of a mathematical structure which deals with changes of all types.

F. To develop an appreciation of the value of the Calculus to the world and its technical areas.

IV. SUBJECT LEVEL CONTENT

A. Analytically discuss curves to develop a thorough insight into geometric forms.

B. To understand the Differential Calculus of algebraic functions and its use.

C. To understand the Integral Calculus of algebraic functions and its use.

D. To develop an understanding of the calculus of elementary transcendental functions.

E. To enlarge one's understanding of the differential calculus to include its many and varied applications.

F. To understand the geometric and physical applications of the process of integration.

V. SUBJECT TIME ALLOTMENT

A.	Analytic Geometry	4 weeks
B.	Differential Calculus (Differentiation)	6 weeks
C.	Integral Calculus (Integration)	8 weeks
D.	Transcendental Functions	8 weeks
E.	Applications (Differentiation)	4 weeks
F.	Applications (Integration)	6 weeks

VI. CONCEPTS, UNDERSTANDINGS, AND SKILLS

A. Analytic Geometry

1. Develop the ability to graph curves in both the rectangular and polar coordinate systems.

2. Develop distance and shape formulas.

3. Establish a detailed working knowledge of straight lines.

4. Develop an extensive understanding of the conics.

B. Differential calculus of angebraic functions

1. Establish the function concept.

2. Establish the meaning of absolute values and inequalities.

3. Define and develop the basic properties of limits.

4. Discuss the fundamental ideas of continuity.

5. Establish the meaning of the slope of a curve and its relation to average and instantaneous rates of change.

6. Define the derivative.

7. Develop methods of formal differentiation.

8. Understand implicit functions and implicit differentiation.

9. Develop an ability to differentiate composite functions and paramentrically defined functions.

10. Define and understand higher order derivatives.

11. Develop the differential and its use in approximation.

12. Discuss Rolle's theorem and the theorem of the mean.

C. Integral calculus of algebraic functions

1. Develop the inverse of differentiation.

2. Develop the ability to integrate simple expressions and use the basic formulas.

3. Establish integration by substitution and integration by parts.

4. Discuss simple differential equations with initial conditions.

5. Develop an intuitive development of the definite integral as the limit of a sum.

6. Develop an intuitive treatment of the fundamental theorem of the integral calculus.

7. Establish the evaluation of simple definite integrals.

8. Discuss the approximation of definite integrals by the trapezoidal rule.

D. The calculus of elementary transcendental functions

1. Develop an understanding of the exponential and logarithmic functions and the inverse relations of these functions.

2. Discuss the derivatives of e^u, ln u, and log a^u.

3. Develop integrals of e^u and $\frac{1}{u}$.

4. Discuss trigonometric functions of real numbers.

5. Discuss: limit of $\frac{\sin x}{x}$ as $x \longrightarrow 0$.

6. Establish the derivatives and integrals of sin u, cos u, and other trigonometric functions.

7. Discuss the derivatives of arc sin u and arc tan u and the corresponding integrals.

8. Develop differential equations of growth and simple harmonic motion.

9. Develop parametric representations involving trigonometric functions for curves such as the ellipse, hyperbola, and cycloid.

10. Discuss simple trigonometric substitutions in integration.

E. Applications of differential calculus

1. Discuss tangents and normals.

2. Develop curve tracing, maximum and minimum points, points of inflection, asymptotes.

3. Discuss problems leading to maximum and minimum values, both relative and absolute.

4. Discuss rates of change.

5. Discuss velocity and acceleration of a particle along a straight line.

6. Discuss velocity and acceleration vectors of motion along a plane curve.

F. Geometric and physical applications of integration.

1. Discuss the area under a curve.

2. Develop the average (mean) value of a function.

3. Discuss areas between curves.

4. Discuss the arc length of a curve.

5. Develop the ability to find volumes of revolution and other simple volumes.

6. Discuss surfaces of revolution and their areas.

7. Discuss motion in a straight line and along a plane curve.

8. Discuss work problems.

VII. METHODS AND TECHNIQUES

A. All topics mentioned previously lend themselves well to the problem solving situation and numerous problems in the text or reference texts are available for discussion and solving. Reference to other authors is extremely adventageous in a course such as this.

B. As much graphing as possible should accompany each suitable section for a visual picture of each situation is far more meaningful than even the most detailed verbal description.

C. Careful teacher explanations and intelligently led pupil discussions are certainly an integral part of every classroom situation. However, specific reference is made to this technique because of the extreme complexity of the theoretical aspect of the calculus. Much time must be spent in discussions for the calculus is especially one topic in mathematics where one may go through the motions but never understanding the underlying significance. The result is a tremendous loss in the ability to apply calculus to practical applications.

D. Seek the advice of departments of mathematics in colleges in this area and colleges to which the students enrolled apply.

VIII. MATERIALS AND TEACHING AIDS

A. Advanced placement publications

B. Any available Calculus texts

C. A series of paperback monographs written especially for advanced placement students is The New Mathematical Library, published by Random House

D. The text

E. Magazine Articles.

F. Publications of the Commission on Mathematics

G. Publications of the National Council of Teachers of Mathematics

H. School Science and Mathematics

I. Films and Filmstrips

J. Charts and posters

K. Models

L. Graphs

IX. EVALUATION

A. Written unit tests

B. Ability of students to use the principles studied to solve practical problems.

C. Final Examination

D. Standardized Tests

E. Advanced Placement Examination

F. Pupil self-evaluation

G. Success of student in college mathematics

In conclusion "the advanced placement course planned for the twelfth year of school - calculus and related analytic geometry - parallels the year course in this subject now given in many colleges. It is achievement in this course for which advanced placement and credit is given by many colleges. It is accordingly achievement in this course that the Advanced Placement Examination in Mathematics is designed to test. The primary objective of the course if to give a substantial training in differential and integral calculus, with sufficient applications to bring out the meaning and importance of the subject." This quote from the Advanced Placement pamphlet 1966 seems to best sum up the total picture of our efforts.